

**Claims:**

- 1           1.     An optical switch, comprising:  
2                 a plurality of transmitting devices integrated on a single  
3     substrate, each of an individual transmitting device including a  
4     directing device;  
5                 a plurality of receiving devices,  
6                 wherein at least a portion of the transmitting devices  
7     direct output beams from the plurality of transmitting devices to  
8     the plurality of receiving devices.
- 1           2.     The switch of claim 1, wherein the plurality of  
2     transmitting devices are integrated on a single substrate in a  
3     batch process.
- 1           3.     The switch of claim 1, wherein the plurality of  
2     transmitting devices includes a plurality of focusing devices,  
3     each of an optical fiber from the plurality of transmitting devices  
4     being coupled to at least one focusing device.
- 1           4.     The switch of claim 1, wherein the plurality of  
2     transmitting devices includes a plurality of directing devices,  
3     each of an optical fiber of the plurality of transmitting devices  
4     being coupled to at least one directing device.
- 1           5.     The switch of claim 1, wherein the plurality of  
2     transmitting devices includes a plurality of focusing devices and  
3     a plurality of directing devices, wherein each of a focusing  
4     device is coupled to a directing device.
- 1           6.     The switch of claim 3, wherein each focusing device  
2     includes at least one lens.
- 1           7.     The switch of claim 5, wherein each lens is selected  
2     from a regular lens, a GRIN lens, a diffractive grating lens, and a  
3     Fresnel lens.

1           8.     The switch of claim 3, wherein at least a portion of  
2     the focusing devices include a micro-collimator.

1           9.     The switch of claim 3, wherein at least a portion of  
2     the focusing devices include an optical waveguide.

1           10.    The switch of claim 3, wherein at least a portion of  
2     the focusing devices include a variable-focus lens.

1           11.    The switch of claim 4, wherein each directing device  
2     is a micro-mechanical device.

1           12.    The switch of claim 4, wherein at least a portion of  
2     the directing devices include an optical waveguide.

1           13.    The switch of claim 11, wherein each micro-  
2     mechanical device includes an actuator.

1           14.    The switch of claim 13, wherein each actuator is  
2     selected from an electro-static actuator, an electromagnetic  
3     actuator, a piezoelectric actuator, a thermo-mechanical actuator  
4     and a polymer actuator.

1           15.    The switch of claim 14, wherein the polymer  
2     actuator is an electro-active polymer actuator, an optical-active  
3     polymer actuator, a chemically active polymer actuator, a  
4     magneto-active polymer actuator, an acousto-active polymer  
5     actuator and a thermally active polymer actuator.

1           16.    The switch of claim 11, wherein each micro-  
2     mechanical device includes a suspension member that provides  
3     movement of a distal portion of an optical fiber of the plurality of  
4     transmitting optical fibers.

1           17.    The switch of claim 16, wherein each suspension  
2     member includes at least one elastic deformation member that  
3     provides a mechanical coupling between a substrate and the  
4     movable part of the directing device.



1           26.    The switch of claim 21, wherein at least a portion of  
2   the focusing devices include an optical waveguide.

1           27.    The switch of claim 21, wherein at least a portion of  
2   focusing devices include a variable-focus lenses.

1           28.    The switch of claim 24, wherein each lens is  
2   selected from a regular lens, a GRIN lens, a diffractive grating  
3   lens, and a Fresnel lens.

1           29.    The switch of claim 22, wherein each directing  
2   device is an micro-mechanical device.

1           30.    The switch of claim 22, wherein at least a portion of  
2   the directing devices include an optical waveguide.

1           31.    The switch of claim 29, wherein each micro-  
2   mechanical device includes an actuator.

1           32.    The switch of claim 31, wherein each actuator is  
2   selected from an electro-static actuator, an electromagnetic  
3   actuator, a piezoelectric actuator, a thermo-mechanical actuator  
4   and a polymer actuator.

1           33.    The switch of claim 32, wherein the polymer  
2   actuator is an electro-active polymer actuator, an optical-active  
3   polymer actuator, a chemically active polymer actuator, a  
4   magneto-active polymer actuator, an acousto-active polymer  
5   actuator and a thermally active polymer actuator.

1           34.    The switch of claim 29, wherein each micro-  
2   mechanical device includes a suspension member that provides  
3   movement of a distal portion of a transmitting optical fiber of  
4   the plurality of transmitting optical fibers.

1           35.    The switch of claim 34, wherein each suspension  
2   member includes at least one elastic deformation member that

3 provides a mechanical coupling between a substrate and at  
4 least a portion of each micro-mechanical device.

1 36. The switch of claim 21, further comprising:  
2 an optical body positioned between each focusing device  
3 and a distal end of each optical fiber of the plurality of receiving  
4 devices. .

1 37. The switch of claim 36, wherein the optical body  
2 includes at least one of a solid optical transparent material, a  
3 liquid optically transparent material, a gaseous optically  
4 transparent material, a gel optically transparent material.

1 38. The switch of claim 1, wherein at least a portion of  
2 transmitting devices are MEMS devices.

1 39. The switch of claim 3, wherein at least a portion of  
2 focusing devices are MEMS devices.

1 40. The switch of claim 4, wherein at least a portion of  
2 directing devices are MEMS devices.

1 41. The switch of claim 21, wherein at least a portion of  
2 focusing devices are MEMS devices.

1 42. The switch of claim 22, wherein at least a portion of  
2 directing devices are MEMS devices.

1 43. The switch of claim 24, wherein at least a portion of  
2 lenses are MEMS devices.

1 44. The switch of claim 1, wherein each of a  
2 transmitting device includes a fiber placement cavity.

1 45. The switch of claim 1, further comprising at least  
2 one transmitter substrate with a plurality of fiber placement  
3 cavities, each of a fiber placement cavity corresponding to a  
4 transmitting device of the plurality of transmitting devices.

46. The switch of claim 45, further comprising at least one receiver substrate with a plurality of fiber placement cavities, each of a fiber placement cavity corresponding to a receiving device of the plurality of receiving devices.

47. The switch of claim 46, wherein each of a transmitter device includes a focusing device and a directing device positioned adjacent to a fiber placement cavity.

48. The switch of claim 47, wherein each of a receiver device includes a focusing device and a directing device positioned adjacent to a fiber placement cavity.

49. The switch of claim 45, wherein each of a transmitter device includes a focusing device and a directing device at least partially positioned in a fiber placement cavity.

50. The switch of claim 49, wherein each of a receiver device includes a focusing devices and a directing device at least partially positioned in a fiber placement cavity.

51. The switch of claim 48, wherein each directing device includes a suspension member that provides movement of a distal portion of a transmitting or receiving optical fiber.

52. The switch of claim 50, wherein each directing device includes a suspension member that provides movement of a distal portion of a transmitting or receiving optical fiber.

53. The switch of claim 1, further comprising:  
a first substrate coupled to the plurality of transmitting devices that include a plurality of transmitting optical fibers, a plurality of focusing members and a plurality of directing members;

a second substrate coupled to the plurality of receiving devices that include a plurality of receiving optical fibers, a

8 plurality of focusing members and a plurality of directing  
9 members.

1 54. The switch of claim 53, wherein at least a portion of  
2 the receiving devices are directed to receive the transmitter  
3 output beams from the plurality of transmitting devices while  
4 simultaneously focusing the incoming beams into the plurality  
5 of optical fibers of the plurality of receiving devices.

1 55. The switch of claim 53, wherein the first and second  
2 substrates each include a plurality of fiber placement cavities. .

1 56. The switch of claim 55, wherein a cross-sectional  
2 dimension of a fiber placement cavity is greater than the size of  
3 the components positioned in the cavity. .

1 57. The switch of claim 53, wherein the plurality of  
2 transmitting devices includes a plurality of elastic deformation  
3 members that provide a mechanical coupling between the first  
4 substrate and a movable parts of directing devices.

1 58. The switch of claim 53, wherein the plurality of  
2 receiving devices includes a plurality of elastic deformation  
3 members that provide a mechanical coupling between the  
4 second substrate and a movable parts of directing devices.

1 59. The switch of claim 1, further comprising  
2 an optically transparent media between transmitting and  
3 receiving devices where light beams from said transmitting  
4 devices can mutually intersect on their way to corresponding  
5 receiving devices.

1 60. The switch of claim 59, wherein the optically  
2 transparent media includes a vacuum, a solid optically  
3 transparent material, a liquid optically transparent material, a

4 gaseous optically transparent material, a gel optically  
5 transparent material.

1 61. The switch of claim 59, wherein optically  
2 transparent media is a system of lenses between transmitting  
3 and receiving devices.

1 62. The switch of claim 61, wherein each lens is  
2 selected from a regular lens, a GRIN lens, a diffractive grating  
3 lens, and a Fresnel lens.

1 63. The switch of claim 1, wherein a number of  
2 transmitting devices and a number of receiving devices are the  
3 same.

1 64. The switch of claim 1, further comprising:  
2 a control system coupled to the plurality of transmitting  
3 devices and plurality of receiving devices, the control system  
4 providing control signals that coordinate positioning of  
5 transmitting devices and receiving devices.

1 65. The switch of claim 1, further comprising:  
2 at least one sensor coupled to the plurality of transmitting  
3 devices and the control system; and  
4 at least one sensor coupled to the plurality of receiving  
5 devices and the control system.

1 66. The switch of claim 65, wherein each of the  
2 plurality of transmitting and receiving devices includes at least  
3 one photosensitive sensor.

1 67. A method for optical switching between input fiber  
2 channels output fiber channels comprising:  
3 providing a plurality of transmitting devices including a  
4 plurality of optical fibers and a plurality of receiving devices

5 including a plurality of optical fibers, the plurality of  
6 transmitting devices being integrated on a single substrate; and  
7 focusing and directing at least a portion of the transmitter  
8 output beams from the plurality of transmitting devices to the  
9 plurality of receiving devices.